# Heat stress: Threatens to undermine export economies and disrupt global supply chains

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This decade is on track to be the hottest on record, and heatwaves are only set to become more frequent and intense as climate change takes hold. Heat stress presents a growing threat to human health and economic productivity globally. Our latest research identifies four regional hotspots – West Africa, Central Africa, the Middle East and North Africa, and South East Asia – where, without adaptation, rising heat stress will drive labour capacity losses in key sectors, with the potential to substantially undermine their export economies.

Using projected daily temperatures from our Heat Stress Indices for the period 1980-2045 and data on the current sectoral composition of export economies, we estimate countries' export value at risk due to rising rates of heat stress associated with climate change. Heat stress can reduce worker productivity by causing dehydration and fatigue, leading to slower work and, in extreme instances, death.

Labour capacity losses due to heat stress are projected to be greater in sectors with higher work intensities *(See: Table 1)*. The extent of exposure to heat stress risks thus depends on the profile of a country's export economy.

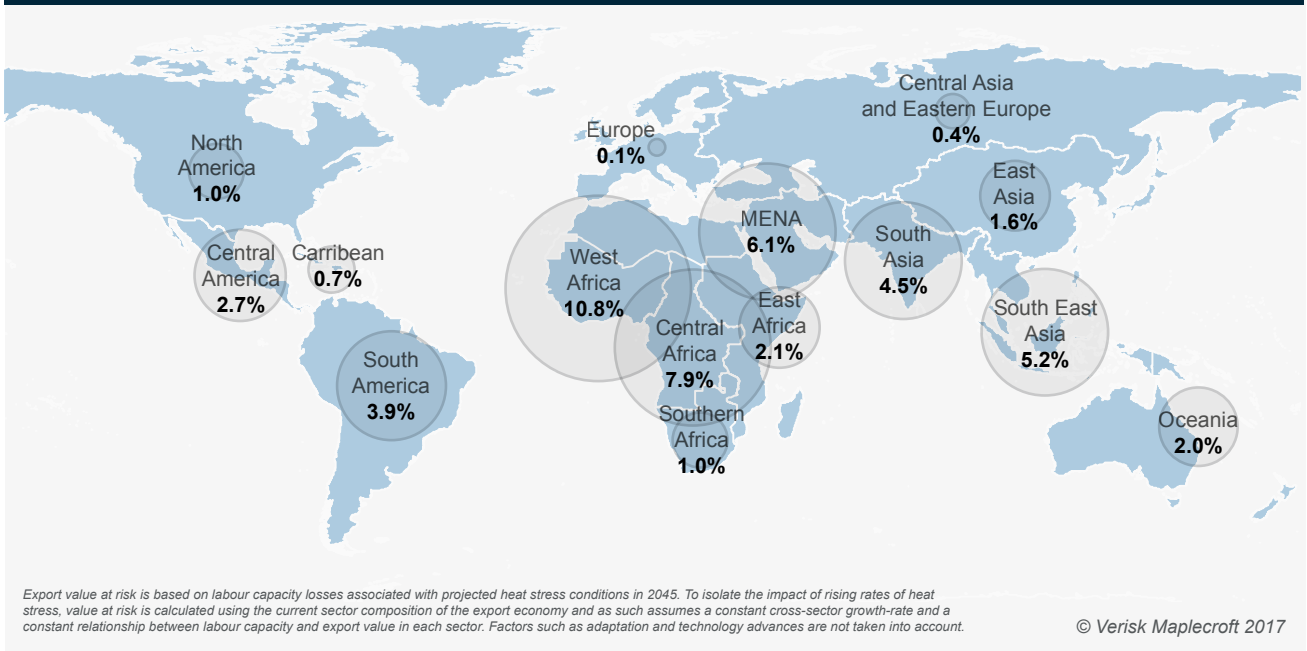
**Table 1: Export sector vs work intensity**

| Export sector | Work intensity category |
|---|---|
| Agriculture, Forestry, and Fishing | High |
| Extractive activities (mining and hydrocarbons) | High |
| Crude Materials for Further Processing | Moderate/high |
| Manufacturing | Moderate |
| Other (Coin and non-monetary gold) | Light/moderate |
| Services | Light |

*Source: Verisk Maplecroft, 2017*

*Photo: iStock*

**Map 1: Percentage export value at risk from heat stress by 2045 by region**




*Source: Verisk Maplecroft, 2018*

Map 1 above identifies the regions expected to experience the worst impacts of rising heat stress due to projected labour capacity losses in key export sectors, assuming no adaptation measures are put in place.

In export markets, labour capacity losses could mean price rises for importers if product availability drops or production costs increase. Supply chain disruption may also drive businesses to source from locations with lower heat stress exposure.

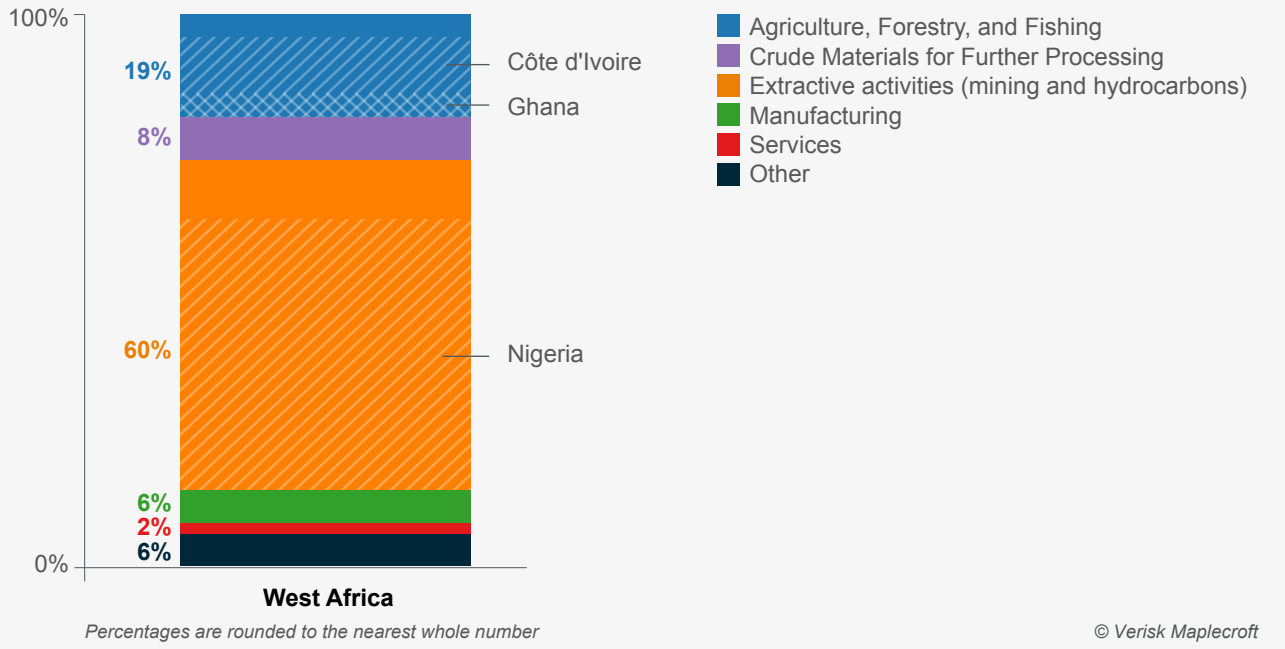
## West and Central Africa face heat stress impacts in extractives and agricultural export sectors

Given the importance of the high work intensity extractives and agricultural sectors to export economies in West Africa, the impacts of rising heat stress on labour capacity are projected to have particularly negative impacts: 10.8% of the region's total export value is projected to be at risk by 2045 *(See: Map 1)*. The extractives sector contributes 60% of this figure, with Nigeria responsible for over three quarters of this *(See: Figure 1)*.

With the agricultural sector contributing the greatest proportion of Cote d'Ivoire's total export value, this country accounts for over half of the export value at risk in the region's agricultural sector *(See: Figure 1)*. Ghana, meanwhile, accounts for just under a quarter. With around 60% of global cocoa exports originating from these two countries, without adaptation, rising heat stress alongside reduced climatic suitability for cocoa production due to climate change could have implications for global supply chains.

The extractives sector is central to export economies in Central Africa, accounting for 88% of the region's total export value projected to be at risk by 2045 *(See: Figure 2)*. Angola and Gabon contribute over half of the export value at risk in this sector. With oil accounting for around 95% and 80% of their total exports respectively, addressing the risks to labour capacity posed by heat stress will be imperative to future economic development.

**Figure 1: Proportion of total export value at risk by sector**



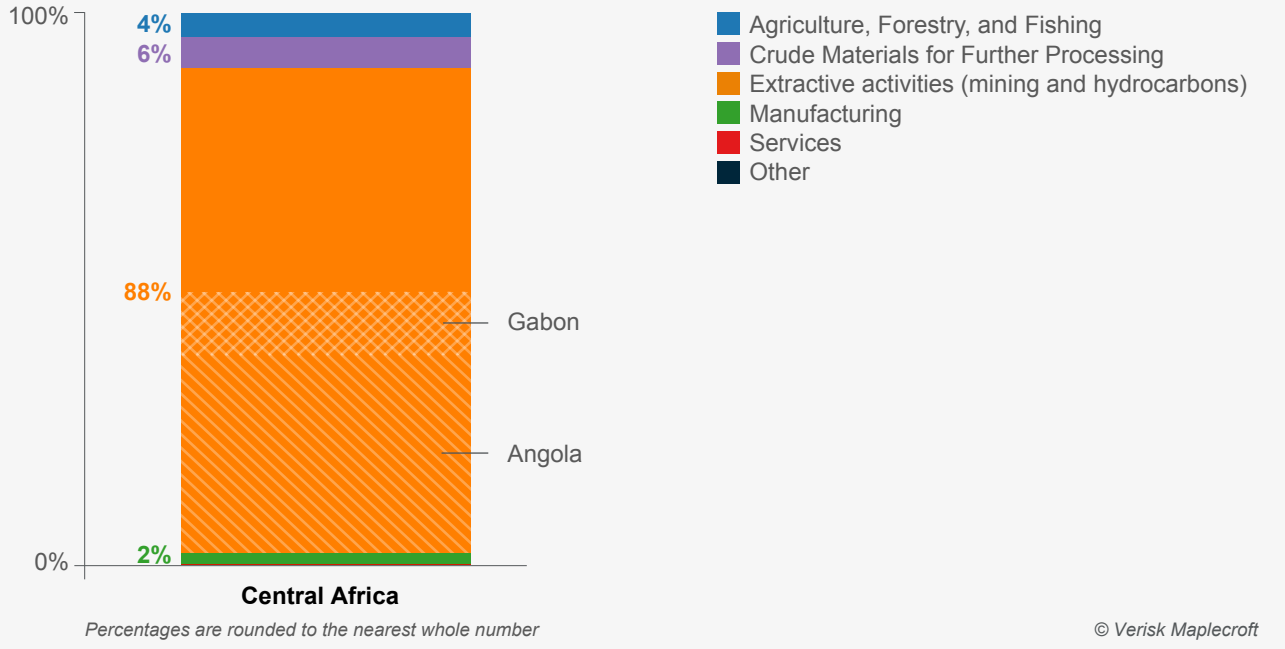

*Percentages are rounded to the nearest whole number*



*Source: Verisk Maplecroft, 2018*



**Figure 2: Proportion of total export value at risk by sector**




*Percentages are rounded to the nearest whole number*



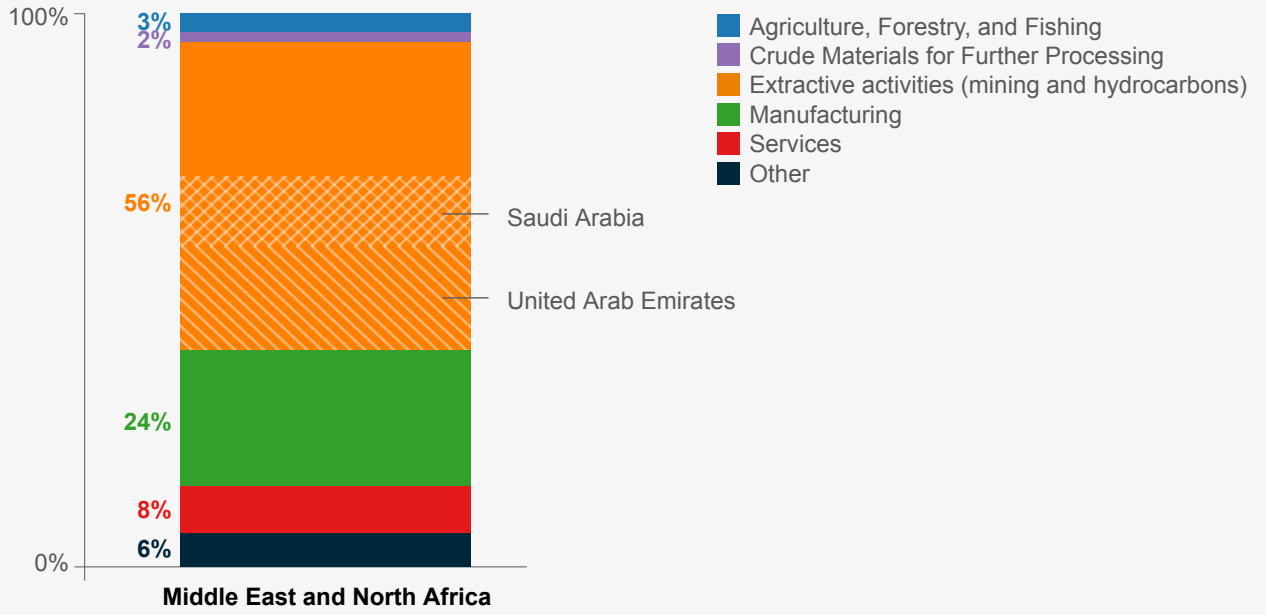
*Source: Verisk Maplecroft, 2018*

## Extractives export sector exposed to heat stress risks in the Middle East and North Africa

The high work intensity extractives sector – including both mining and petroleum products – is important for exports in the Middle East and North Africa. As such, without adaptation, heat stress and associated labour capacity losses are expected to have negative impacts on export economies in the region; 6.1% of total export value is projected to be at risk by 2045 *(See: Map 1)*.

The United Arab Emirates and Saudi Arabia account for over half of total export value at risk in the region's extractives export sector *(See: Figure 3)*. Recognising the risks posed by heat stress, several Middle Eastern countries have implemented regulations restricting outdoor working hours during summer months in sectors such as construction, however, oil and gas workers are often excluded.

**Figure 3: Proportion of total export value at risk by sector**



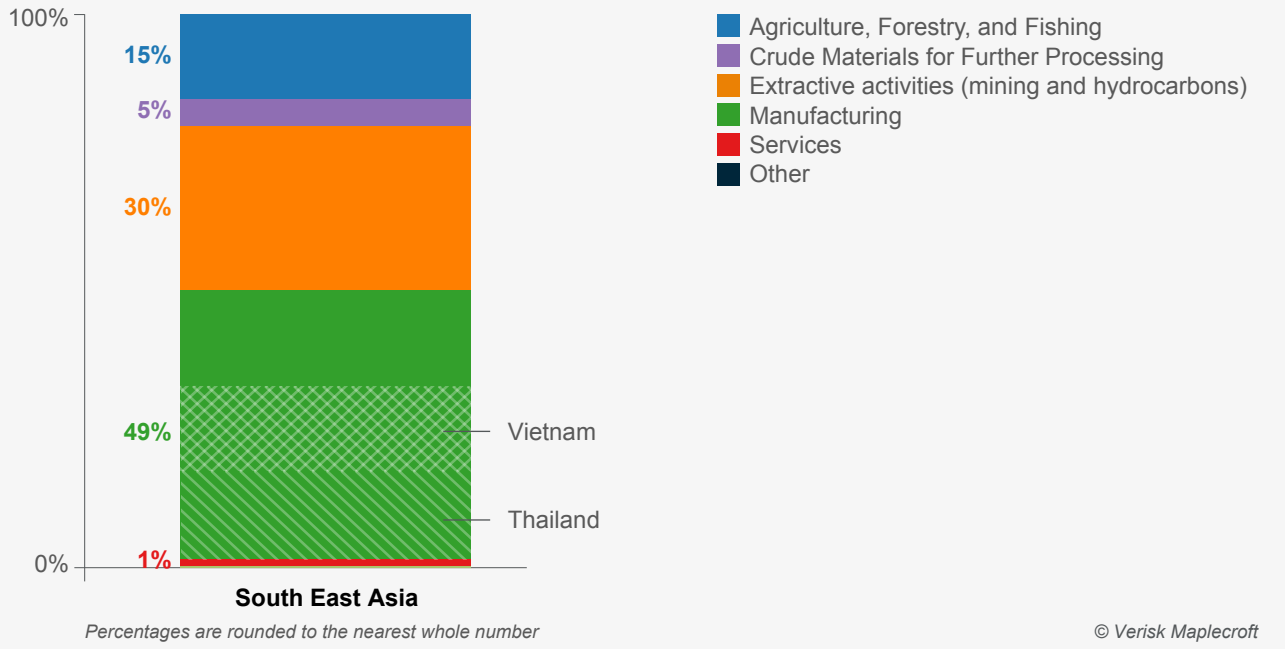

*Source: Verisk Maplecroft, 2018*

## Heat stress threatens South East Asia's manufacturing export sector

With the comparatively less work-intensive manufacturing industry *(See: Table 1)* the dominant export sector, South East Asia is estimated to have the fourth highest regional export value at risk – 5.2% – by 2045 as a result of heat stress-induced labour capacity losses *(See: Map 1)*.

Vietnam and Thailand – key exporters of machinery and electrical components – account for almost two thirds of the region's total manufacturing export value projected to be at risk by 2045 *(See: Figure 4)*. While adaptation measures such as cooling systems can be implemented, such measures are likely to elevate production costs in these locations, which will be passed on to importers. Conversely, without adequate enforcement of labour standards and action to mitigate heat stress risks, dependent supply chains globally could face disruption risks.

**Figure 4: Proportion of total export value at risk by sector**




*Source: Verisk Maplecroft, 2018*

## Timely action is key

Our investigation shows that, without adaptation, rising heat stress will present an economic threat, particularly for countries with export economies heavily dependent on high work intensity sectors or individual industries. Forward-looking companies can mitigate heat stress risk through a range of measures, including sector diversification, changing work patterns, seasonal adjustment of output targets, and climate control. However, such efforts will require significant investment, which many developing economies will struggle to mobilise. The future impacts of rising heat stress on global export markets thus remains an ongoing uncertainty.

# Cooling Degree Days: Energy demand for cooling is set to soar in future as temperatures rise and heatwaves become more frequent

Rising temperatures and more frequent heatwaves associated with climate change will drive greater energy demand for cooling in the coming decades. As a result, businesses face spiralling operational costs and greater risks of power outages.

In 2016, global energy use for cooling amounted to just over 2,000 terawatt hours (TWh), and this figure is set to triple by 2050.[4] Here, we investigate which parts of the world face the greatest increase in energy demand and where demographic trends and limited power system resilience could put supplies at risk.

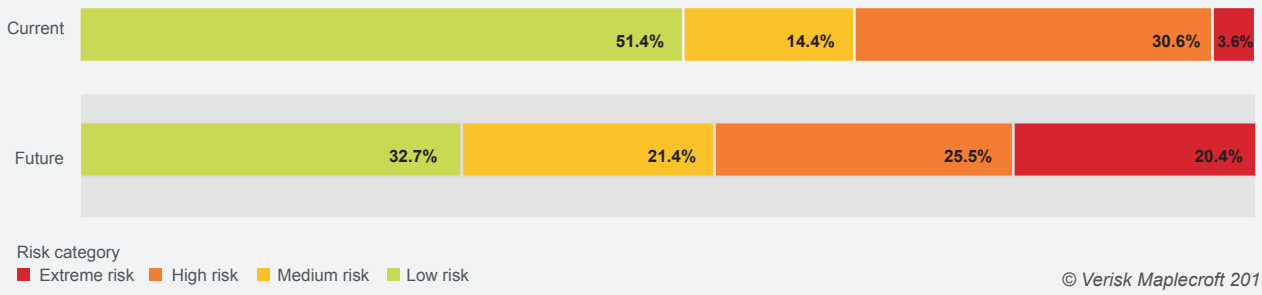
## Rising temperatures and population growth driving up energy demand

Our Cooling Degree Days indices identify locations expected to see the greatest increase in energy demand for cooling over the next 30 years. Cooling degree days are a measure of how far (in degrees) and for how long (in days) the outside temperature is above a threshold temperature, and can be used to estimate energy demand for cooling.

We project that the proportion of the global population in the extreme risk category in our Cooling Degree Days Index will be five times higher than today by mid-century *(See: Figure 5)*. In addition to increasing global temperatures, this trend is driven by the fact that population growth is projected to be greater in warmer countries. Indeed, the population in countries classified as extreme and high risk in our Cooling Degree Days (current climate) Index is set to increase by 51% by 2050, compared with just 16% growth in countries in medium and low categories.

Alongside rapid population growth, there is an upward trend in global urbanisation. By 2050, another 2.7 billion people are projected to be living in cities – where cooling demand is greatest – which will intensify the strain on electricity infrastructure. Urbanisation rates are particularly high in emerging economies, many of which are in regions expected to see the greatest average temperature rises *(See: Map 2)*.

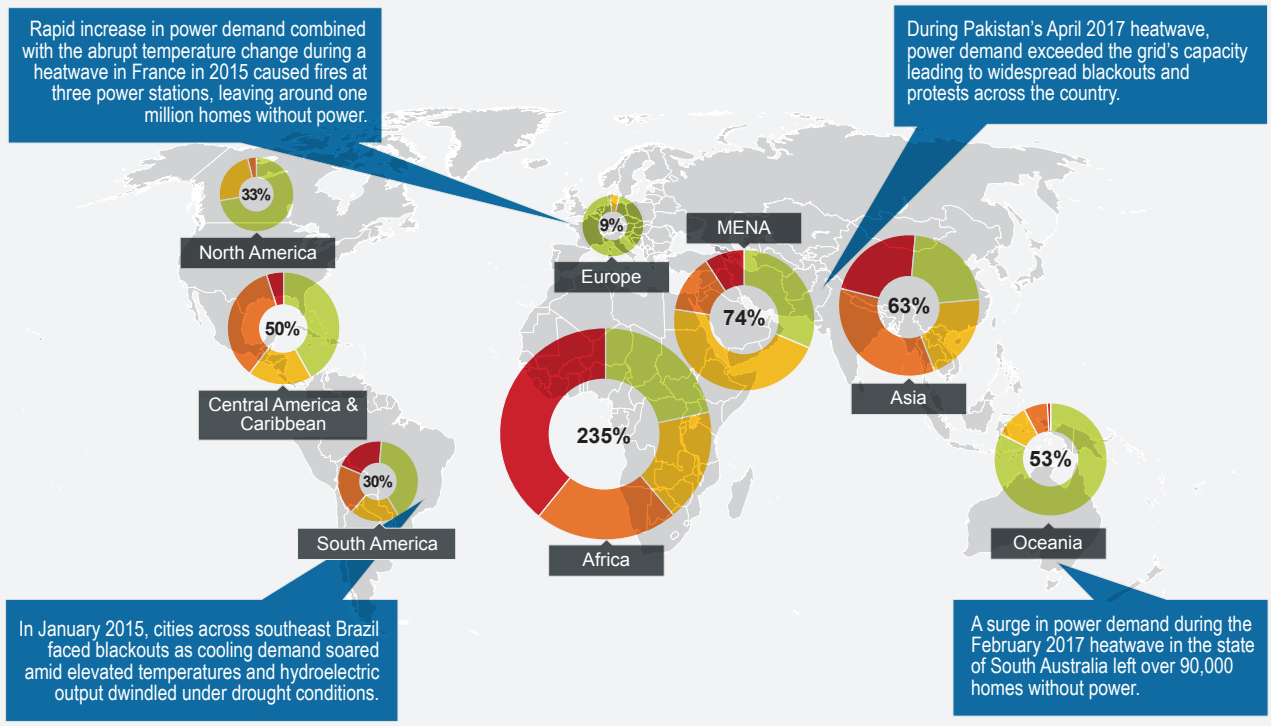
**Figure 5: Proportion of global population in each risk category in our current and future Cooling Degree Days Indices**






*Source: Verisk Maplecroft, 2018*

**Map 2: Urbanisation rates are projected to be most rapid in regions expected to experience greatest temperature increases**




*Verisk Maplecroft, 2018; United Nations, Department of Economic and Social Affairs, Population Division, 2018*

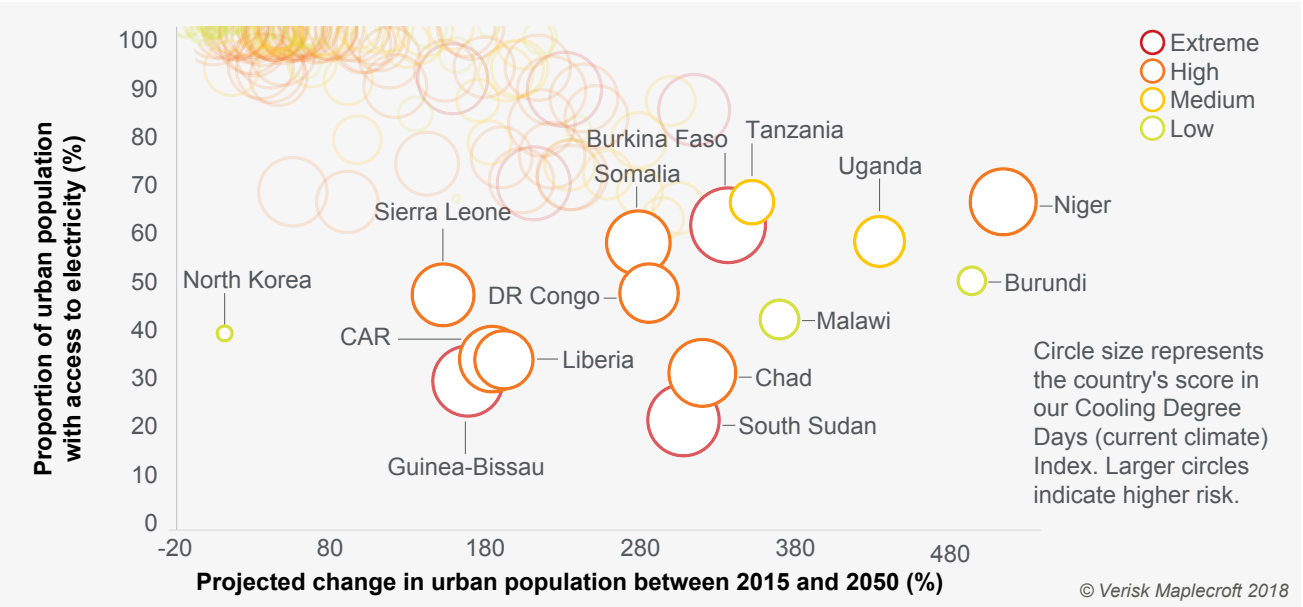


*Sources: Verisk Maplecroft, United Nations, Department of Economic and Social Affairs, Population Division, 2018*

## Where are energy systems prepared to handle the heat?

Businesses in countries where the development of power infrastructure is not keeping pace with rates of urbanisation face growing risks of operational disruption *(See: Figure 6)*. We use data on current urban access to electricity (a proxy for the strength of national power infrastructure) and urban population projections for 2050 to identify the countries that will face the greatest challenges.

**Figure 6: Disruption risks are greatest in countries with weak electricity infrastructure and rapidly growing urban populations**




*Source: Verisk Maplecroft, 2018; United Nations, Department of Economic and Social Affairs, Population Division, 2018; World Bank, 2018*

Countries classified as extreme risk in our Cooling Degree Days (current climate) Index face the double whammy of weak electricity infrastructure and an exploding urban population. In these countries, only 79% of city-dwellers have access to electricity compared to a global figure of 97%; meanwhile, the urban population is projected to grow three times faster than the global average.

Africa is set to experience the highest increase in cooling degree days in future and so faces the greatest risks *(See: Map 2)*. Only 76% of the urban population in Africa has access to electricity, while the region's urban population is expected to grow by 235% by 2050. On average, countries in the region lose 20% of electricity through power transmission and distribution losses, while firms face an average of eight outages a month. These challenges mean that even if governments take much-needed action to strengthen energy infrastructure, power capacity increases are unlikely to keep pace with growing demand.

Nor does the future look bright for Asia's manufacturing hubs, where operators in key locations such as Dhaka and Delhi will be vulnerable to future electricity shortages and blackouts. Indeed, power outages occur almost annually during India's summer heatwaves. In 2015, a heatwave caused over 2,000 deaths across the country, while power failures triggered by spikes in electricity demand for air conditioning disrupted businesses. With India's urban population set to more than double by 2050, power supply interruptions could become commonplace.

And even in Europe – which is expected to see the lowest increase in cooling degree days – heatwaves pose disruption risks to businesses, as experienced in recent years *(See: Map 2)*.

## Failure to strengthen power systems could mean lights out for business

It's not just a case of meeting average electricity demand as cooling requirements rise in a warming climate: power systems must also be able to handle peak demand. Without enhanced efficiency or infrastructure improvements, locations with weak power grids may experience widespread blackouts during heatwaves when cooling requirements soar. Businesses not only face the prospect of additional operating costs in future, but also more frequent disruption.

Our investigation illustrates that action will need to be taken globally to strengthen the resilience of urban energy infrastructure. Measures such as diversifying energy supplies by integrating a greater proportion of renewables, utilising smart grid technologies, and improving energy efficiency could mitigate future disruption risks. And, in developing regions, the development of off-grid renewable energy systems could be key to reducing risks of power outages. But these measures will require significant investment and multi-stakeholder collaboration. The question therefore remains: will supply meet demand or will businesses be left in the dark?

## Endnotes

4. International Energy Agency (IEA) and Organisation for Economic Co-operation and Development (OECD), 2018, The Future of Cooling: Opportunities for energy efficient air conditioning. Available at: http://www.iea.org/publications/freepublications/publication/The_Future_of_Cooling.pdf

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